In re Patent Application of:
AMMAR
Serial No. **09/863,030**
Filing Date: **May 22, 2001**
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REMARKS

Claims 1, 3-10, 12-16, and 18-26 remain in this application. Claims 2, 11, and 17 have been cancelled. Claims 1, 9, 10, 12, 13, 14, 16, 19, 21, 22, and 26 have been amended.

Applicant thanks Examiner Mondt for the detailed study of the application and the suggestions for overcoming some of the inconsistencies in the claims.

Applicant has amended the independent claims to place those claims in condition for allowance. Also, Applicant has amended the specification to delete the word "directly" concerning the MMIC chips attached to the substrate. The word "directly" was used because no packages in which MMIC chips are mounted were intervening between the MMIC chip and board on which the MMIC chips were surface mounted. Instead, solder, a conductive adhesive, or CTE matched shims can be used in the present invention.

Independent claims have been amended in line with the suggestions of the Examiner to overcome the inconsistencies regarding the planar top surface. Also, claim 1 and other claims recite that the MMIC chips are attached to the top surface of the substrate board by solder, conductive adhesive, or shims. As noted in the specification, the chips may be attached to the base plate using CTE matched shims.

Applicant notes the rejection by the Examiner of claims 10-26 as obvious over U.S. Patent No. 5,982,250 to Hung et al. (hereinafter "Hung") in view of U.S. Patent No. 6,175,287 to Lampen et al. (hereinafter "Lampen"), and U.S. Patent No. 6,386,085 to Miehls et al. (hereinafter "Miehls").

Other claims were rejected over Hung in view of Lampen and Miehls and further in view of Osika, Murphy, or Chan.

Applicant notes that Hung is specifically directed to a millimeter wave, low temperature co-fired ceramic package to form a waveguide-to-microstrip transition. Hung includes a MMIC chip contained in a cavity for use at microwave and millimeter-wave frequencies of approximately 20 to about 100 GHz. The transition in Hung is an integral part of his invention and requires microstrip and impedance matching circuit components. Thus, the design of LTCC package is important and, as illustrated, includes a plurality of ceramic layers and intervening planar sheets of conductive layers. This is clearly shown in FIGS. 2 and 3. The ceramic layers include conductive vias that extend between the conductive layers and beyond a ground layer 216, which has the MMIC attached. This type of structure is necessary to form the cavity, the land region, and transition 124. The vias are placed around the transition to form an extension to the waveguide structure. Hung clearly teaches at column 4, starting at line 38 and continuing to column 5, line 8, his structure with the plurality of low temperature, co-fired ceramic layers with the intervening conductive layers to form the waveguide transition. Hung teaches:

> "One aspect of the package 100 is illustrated in FIG. 2. FIG. 2 shows a side view, taken along line A-A', of the multi-layer integrated circuit package 100 shown in FIG. 1. Still referring to FIG. 2, the package 100 includes a metal base 202, a metal cover 204, a ring

frame 206, and a multi-layer integrated circuit 208 (hereafter "circuit 208").

The circuit 208 includes conductive layers 210-220 (which may be filled, for example, with conductive metal) separated by dielectric layers 222-230. Note that any conductive layer may be selectively patterned to provide DC bias and signal routing. In a preferred embodiment, the circuit 208 is formed from dielectric layers created from Low Temperature Co-fired Ceramic (LTCC). Vias 232 are introduced into the circuit 208 to provide signal routing (including millimeter-wave signal, DC power, ground, and data) between the conductive layers 210-220 of the circuit 208. The package 100 also includes a waveguide structure which will be explained in more detail below with reference to FIG. 3 (which illustrates a side view of the transition 124 taken along line B-B' of FIG. 1).

In FIG. 3, the waveguide structure 234 may be created directly as part of the circuit 208 fabrication process. The circuit 208 thereby remains hermetically sealed, and easy to manufacture. The waveguide structure 234 may be created, for example, by punching out the dielectric layers 222-226 and screen patterning the conductive layers 210-216 at appropriate locations, co-firing the dielectric layers 222-226, and then depositing an electromagnetically reflective coating 236 over the surface of the punched out region to provide signal reflection in the waveguide structure 234. The waveguide structure 234 continues through an opening 238 in the metal base 202 to reception or transmission structure, for example, a feedhorn (not shown. In an alternate embodiment, a series of plated vias extends through the dielectric layers 222-226 surrounding the waveguide structure 234, in addition to or as a substitute for the reflective coating 236 on the inside of the waveguide structure 234."

The present claimed invention is opposite from Hung. Not only does the present claimed invention include more than one MMIC chip, but it is structured and designed to form a thick film millimeter wave transceiver module, where a plurality of MMIC chips are arranged, for example, as a transceiver in transmitter, receiver and local oscillator sections. Isolation is necessary between transmit and receive signals, while also maintaining interconnection among devices, ground signals, and any MMIC chip, secured by solder, conductive adhesive, or shims. The planar sheets of low temperature, co-fired ceramic material are stacked and bonded together without intermediate conductive sheet layers as in Hung so as to constitute a single planar substrate having one planar bottom sheet with a planar bottom surface and one planar top sheet with a planar top surface. The substrate is received on a base plate.

The substrate board is novel and unobvious and includes a lower DC signals layer formed from a separate sheet and having signal tracks and connections. A ground layer is formed from a separate sheet and has ground connections and is positioned over the DC signals layer. A device layer is formed from a separate sheet and has capacitors and resistors embedded therein that connect to MMIC chips and positioned over the ground layer. Isolation and/or interconnect and/or ground vias extend through the device layer to the ground layer. The vias often will not extend into the lower DC signals layer, as set forth in the specification on page 14 starting with the paragraph at line 19. The present invention, in one aspect, also includes a channelization plate that has channels formed to receive the MMIC chips and provide

isolation by air in this example between transmit and receive signals.

Thus, the present claimed invention is more than a simple stacked layer of low temperature, co-fired ceramic sheets with intervening sheets of conductive layers as in Hung to form a waveguide transition. The present claimed invention is a novel and unobvious transceiver module having a specific design in the stacked and bonded ceramic material formed as planar sheets of low temperature, co-fired ceramic material. A lower DC signals layer, ground layer, and device layer are positioned in a desired configuration, allowing the isolation and/or interconnect and/or ground vias to extend through the device layer to the ground layer.

Indeed, Hung shows a ground layer as a top layer 216. This is opposite from the present claimed invention, which includes a device layer formed from a separate sheet and having capacitors and resistors embedded therein that connect to the MMIC chips and positioned over the ground layer, which includes the ground connections. This ground layer is, in turn, positioned over the lower DC signals layer. This type of structure with the interconnects allows the MMIC chips to be positioned and operative with the various layers to form a transceiver module that permits transmit and receive signal transmission, isolation and operation.

As to Lampen, used by the Examiner to teach a plurality of MMIC chips, Applicant notes that Lampen is directed to solving bond wire problems on a single substrate. Radio frequency and direct current interconnects are formed by wire or ribbon bonds. Lampen is specifically directed to an interconnect improvement and does not disclose or suggest the

present claimed invention. At most, the combination of Hung and Lampen would suggest a waveguide transition having a better interconnect structure to a MMIC chip and other devices positioned on a top ground layer.

As to Miehls, it may disclose low temperature, co-firing of ceramic multilayer circuit boards, but it is specifically directed to forming a board with laminated edges and a retaining pin at this edge. Miehls nowhere discloses or suggests the present claimed invention.

Osika may disclose the use of some isolation vias, but it is directed to a wafer substrate test structure and nowhere discloses or suggests the present claimed invention. At most, it discloses the use of vertical grooves or trenches that are small in micron size for "air bridging."

Chan had been discussed before and discloses a millimeter wave ceramic package having a cavity where one or more MMIC chips can be connected to peripheral components outside the package by RF transmission lines as peripherals extending through the package. Chan teaches, at most, a base, which could be ceramic, and a ceramic sheet on top that does not form a top surface, but instead forms a cut-out to form a cavity in which MMIC chips are received. The inside periphery of the cavity includes RF signal lines that extend outward. Chan nowhere suggests any multilayer thick film substrate board used in millimeter wave transceiver modules with planar sheets of low temperature, co-fired ceramic material, bonded together and the layers positioned and formed as claimed.

Murphy discloses another microstrip-to-waveguide transition and teaches a substrate thickness of about 5 mil total. It nowhere suggests the present claimed invention with

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the specific structure, position of layers and isolation/ground and/or interconnect vias that are operative for interconnecting different components embedded in the different layers. The present claimed invention also does not include the conductive layers of sheet, such as screen printed, as a planar layer intervening between each dielectric material, as in Hung.

Applicant contends that the present case is in condition for allowance and respectfully requests that the Examiner issue a Notice of Allowance and Issue Fee Due.

If the Examiner has any questions or suggestions for placing this case in condition for allowance, the undersigned attorney would appreciate a telephone call.

Respectfully submitted,

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I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: **MAIL STOP NON-FEE AMENDMENT, COMMISSIONER FOR PATENTS, P.O. BOX 1450, ALEXANDRIA, VA 22313-1450**, on this 5th day of February, 2004.

Julie Lalan